REMARKS

This Amendment cancels claims 10 and 13, and amends claims 1-9, 11-12 and 14 in accordance with the original disclosure. The term "mobile machine" has been replaced with "industrial truck", and the subject matter of claim 13 now appears in claim 5, as amended. Claims 1, 2 and 3 have been amended to further characterize the invention as compared to the cited art and includes patentable distinctions not found in the cited art.

THE INVENTION

The invention is addressed to a battery-operated industrial truck which has two drive motors or drive units that work as generators. One of the drive motors is used for the traveling operation of the truck and the other drive motor is used to operate the hydraulic devices carried by the truck, for example, the lifting/lowering operation of the load support or the hydraulic steering actuator. In this instance, the other electric motor drives a hydraulic pump, and the operation of the lifting and lowering device or the hydraulic steering actuator can be activated or deactivated via a hydraulic breaking device. For the traveling operation, the respective electric motor drives the driving wheel directly or via gearings. That is, the industrial truck of the invention has two electrical motors, one for driving the truck and the other for operating the hydraulic system of the truck, which generally will include the hydraulics for the lifting and lowering mechanism. These features of an industrial truck are now broadly recited in amended claim 1.

Figure 1 of the instant application represents a circuit arrangement for a conventional industrial truck. As shown in Figure 1, the industrial truck has two motors 4, 5, as well as an electrical energy storage mechanism 6 and a braking resistance 7. If the truck is braked by motor 4, the motor 4 functions as a generator and supplies electricity to control system 3, which transmits the electricity to the electrical energy storage mechanism 6 or to the braking resistance 7. If the electrical energy storage mechanism 6 is fully charged, the energy can only be reduced by means of the braking resistance 7, which converts the energy into heat, which, in turn, must be provided with sufficient heating.

The invention sets out to improve this conventional arrangement for an industrial truck by significantly reducing the complexity and overall size of the drive system. The invention is illustrated in the arrangements of Figures 2 and 3. In Figure 2, the circuit diagram shows a control system 12 for actuating motors 4 and 5. If the industrial truck is

decelerated by motor 4, motor 4 acting as a generator supplies electricity to control system 12, which transmits the electricity to motor 5. Motor 5 drives hydraulic pump 8, which transports hydraulic fluid to a control valve block 10, which, in turn, regulates the feed of the hydraulic fluid to the hydraulic devices such as the lifting and tilting cylinders of a load lifting platform or the hydraulic steering actuator. If the hydraulic pump 8 supplies more hydraulic fluid than is required by the hydraulic devices, the excess fluid is transported via a pressure reducing valve into reservoir 9 and the energy is dissipated. (See paragraph [0023] of the specification.) The features and operation of the circuit diagram of Figure 2 are broadly recited in amended claim 1.

In Figure 3, the industrial truck incorporates the features of Figure 2 in addition to hydrodynamic brake 15 and an electrical energy storage mechanism 13. (Applicant points out that this hydrodynamic brake 15 is associated with the hydraulic devices carried by the industrial truck.) If the industrial truck is decelerated and the motor 4 supplies electricity to control system 14, the control system 14 transmits this energy to the electrical energy storage mechanism if no energy is required to be supplied to motor 5 for operation of its associated hydraulic system. On the other hand, if the motor 5 requires energy during the braking or deceleration process of motor 4, for example, because hydraulic cylinder 11 is actuated simultaneously, the energy during the braking at the motor 4 is preferably supplied directly to the motor 5. (See paragraph [0026] of the specification.)

Paragraph [0028] of the instant specification teaches that if the electrical energy storage mechanism 13 is no longer able to absorb any additional energy or if absorption of additional energy is no longer desired, the energy can be discharged via the hydraulic circuit, which can be done via the hydraulic braking device 15, via the pressure relief valve in control valve 10, or via both devices simultaneously.

The features and operation of the circuit diagram of Figure 3 are broadly recited in amended claims 2 and 3, which depend directly or indirectly on claim 1. In summary, the claimed invention in amended claim 1 uses the excessive energy generated during deceleration of the first motor 4 and directs this energy to second motor 5 whereby any unused energy is transported into reservoir 9 where it is dissipated. As reflected in amended claims 2 and 3, the excessive energy is selectively diverted to the electrical energy storage mechanism for later use if this energy is not needed by second motor 5 or directly to second motor 5, if needed. If either the electrical energy storage mechanism cannot absorb

this excessive energy or the second motor 5 does not require this excessive energy, this energy can be discharged via the hydraulic circuit either through the hydraulic braking device 15, the pressure relief valve or through both.

REJECTION OF CLAIMS UNDER 35 U.S.C. § 103

Claims 1-4, 7-12, and 14 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Lateur et al., U.S. Patent No. 5,823,280 (Lateur reference) in view of Nathan et al., U.S. Patent No. 6,454,033 (Nathan reference).

The Examiner's position is that the Lateur reference teaches, in Figures 1-8 and respective portions of the specification, a mobile machine, comprising at least two electrical drive systems 12, 14; at least one electrical control system 26; and at least one electrical power source 24. This patent also teaches generating energy during deceleration and sensing the state of charge of a battery and of balancing the torque of a first motor/generator to balance the torque of a second motor/generator. This reference does not teach supplying energy from the first electrical drive to the second electrical drive rather than to an electrical storage mechanism.

The Nathan reference is said to teach a mobile machine that includes an electrical drive and a hydraulic drive transmission that is powered by the electrical drive. This reference also teaches a regenerative braking mode and the steps of sensing the state of charge of a battery, and if the battery is at full charge, then a hydraulic pump 4 is operated to release the energy accumulated from deceleration.

The Examiner states that it would have been obvious to one having ordinary skill in the art at the time of the invention to use a hydraulic transmission, as taught by the Nathan reference as the torque transmission 18 means in the invention taught by the Nathan reference, and that one would be motivated to use the teachings of the Nathan reference for using a hydraulic pump, while braking when a battery is at full charge to prolong the lifespan of the battery in the invention taught by the Lateur reference.

Applicant disagrees with the Examiner's position. Firstly, both of these references apply to vehicles that attain high speeds for travel on the highway; whereas, the vehicle of the claimed invention relates to an industrial truck which carries loads and which travels at low speeds and mostly indoors.

Secondly, the drive arrangements in both references are used to operate a drive shaft for driving the wheels of a high-speed vehicle; this is demonstrated in Figure 1 of the Lateur reference and in Figure 1A of the Nathan reference. In view of this, whatever occurs in the drive systems of these references will, in general, ultimately affect the torque or speed of the vehicle. In the Lateur reference, both the first and second motors 12, 14 are coupled via a planetary gear system 18 to the vehicle's drive transmission 20. A heat engine 22 is coupled via a clutch 82 to the first motor 12. During the all-electric mode, both motors 12, 14 are operated to drive the transmission 18. As described in column 1, lines 26-30 of the Nathan reference, the invention provides a vehicle with an electro-hydraulic drive which optimizes the operating conditions of the electrical motor powered by a battery and obtains both a high starting torque when necessary and speeds sufficient to allow the vehicle to speed without having to over-dimension the hydraulic components.

In contrast to this, the claimed invention is addressed to an industrial truck which has one electrical motor for driving the vehicle and one electrical motor for operating the hydraulic system which, in turn, operates hydraulic devices carried by the truck, such as the load lifting and lowering device and the hydraulic steering actuator.

Thirdly, the drive arrangement of the Lateur reference discloses two electrical motors 12, 14, at least one electrical control system 26, and at least one electrical power source 24. The Nathan reference discloses an electrical drive 60 and a hydraulic drive transmission 3 that is powered by the electrical drive. However, Applicant fails to see how the use of a hydraulic transmission as taught by the Nathan reference as the torque transmission means 18 of the Lateur reference would make the claimed invention obvious. If the hydraulic transmission of the Nathan reference is used to replace the torque transmission means 18, then this means 18 would simply drive the shaft 62 which, in turn, drives the wheels which motivates the vehicle. Also, as can be seen in Figure 1 of the Lateur reference, both motors 12 and 14 provide input to the torque transmission 18. As disclosed in column 4, lines 63 to column 5, line 1. A first rotor 58 (of motor 12) includes a sun gear 74 which is in engagement with the planet gears 68, and the second rotor 60 (of motor 14) includes a ring gear 76 engaged with such planet gears. By virtue of this arrangement, the rotational speed of output shaft 62 is dependent upon the difference between the rotational speeds of the first and second rotors 58 and 60. In contrast to this, and as discussed hereinabove, the invention as claimed has a hydraulic system which is associated with the hydraulic devices carried by

the industrial truck and does not have a hydraulic transmission associated with the drive system for driving the vehicle.

Fourthly, the drive system of the claimed invention is totally different from that of either of these two references. As discussed herein above, the drive system of the invention has two electrical motors 4, 5, one for driving the industrial drive and one for driving a hydraulic system for operating the hydraulic devices carried by the industrial truck. As taught in the first embodiment and as recited in amended claim 1, when motor 4 decelerates, the energy generated through this deceleration is transferred to motor 5 for driving the hydraulic devices, and if motor 5 does not require this energy, then it is dissipated in the hydraulic system. As taught in the second embodiment and as recited in amended claims 2 and 3, when motor 4 decelerates, the energy generated through this deceleration is transferred into electrical storage system 13 if motor 5 does not require this energy or is transferred to motor 5, if it does require this energy. This stored energy can then be transported back to both motors 4 and 5, if required. Also, if motor 5 does not need some of the energy transferred to it, this energy may be dissipated in hydraulic braking device 15, which is used for the hydraulic devices carried by the industrial truck and not for braking motor 4 for travel of the industrial truck.

In view of the amendments to the claims and the above comments with regard to the references and the claimed invention, Applicant submits that claims 1, 2, and 3 are patentably distinct from the two references when considered singly or in combination. Claims 4, 5, 7-9, 11-12, and 14 are also patentable on their merits in addition to being directly or indirectly dependent on patentable claims 1, 2, or 3.

REJECTION OF CLAIM UNDER 35 U.S.C. § 103

Claim 6 is rejected under 35 U.S.C § 103(a) as being unpatentable over Lateur reference in view of Nathan reference as disclosed above, and further in view of Sauka et al., U.S. Patent No. 4,278,298 (the Sauka reference). Claim 6 is dependent on claim 5, which is dependent on claim 1. The Lateur and Nathan references have been discussed hereinabove. The same arguments propounded above for the patentability of claims 1-3 apply here with equal force with regard to claim 6. The Sauka reference adds nothing further to negate the patentability of claim 6.

CONCLUSION

In view of the above remarks and amendments to the claims, reconsideration of the rejections and allowance of claims 1-9, 11-12, and 14 are respectfully requested.

Respectfully submitted,

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